

# Frequency Mixer

# TUF-3SM+

## Typical Performance Data

RF (IN) (MHz)	LO (MHz)	CONVERSION LOSS IF FIXED @IF(OUT)=30MHz (dB)			RF (IN) (MHz)	LO (MHz)	IP3 INPUT (dBm)			RF (IN) (MHz)	LO (MHz)	COMPRESSION @RF IN=+1dBm (dB)		
		@LO (dBm)					@LO (dBm)					@LO (dBm)		
		+4	+7	+10			+4	+7	+10			+4	+7	+10
0.15	30.2	5.84	5.60	5.46	10.1	40.1	17.19	21.35	19.03	10.1	40.1	1.15	0.81	0.57
0.2	30.2	5.75	5.52	5.39	27.8	57.8	18.32	18.01	19.22	27.8	57.8	1.07	0.80	0.57
0.3	30.3	6.69	5.47	5.33	45.5	75.5	19.83	18.86	24.60	45.5	75.5	1.22	0.83	0.61
0.5	30.5	5.64	5.41	5.28	63.2	93.2	20.63	23.22	18.46	63.2	93.2	1.05	0.77	0.54
1.0	31.0	5.54	5.31	5.20	80.9	110.9	16.80	26.58	16.94	80.9	110.9	0.97	0.74	0.52
1.5	31.5	5.47	5.25	5.14	98.6	128.6	25.04	16.13	14.33	98.6	128.6	1.00	0.64	0.52
2.0	32.0	5.44	5.22	5.10	116.3	146.3	18.41	17.83	17.27	116.3	146.3	0.96	0.66	0.49
5.0	35.0	5.44	5.19	5.06	133.9	163.9	18.99	15.58	14.06	133.9	163.9	0.94	0.72	0.53
10.0	40.0	5.46	5.21	5.07	151.6	181.6	14.11	13.19	13.45	151.6	181.6	0.96	0.72	0.56
27.8	57.8	5.11	4.78	4.63	169.3	199.3	12.04	10.62	10.62	169.3	199.3	0.83	0.64	0.49
45.5	75.5	5.16	4.84	4.72	187.0	217.0	14.03	12.27	13.06	187.0	217.0	0.89	0.64	0.50
98.6	128.6	5.10	4.84	4.72	204.7	234.7	21.75	26.48	21.67	204.7	234.7	0.92	0.69	0.51
116.3	146.3	5.16	4.92	4.79	222.4	252.4	19.43	19.51	21.84	222.4	252.4	0.94	0.72	0.57
133.9	163.9	5.14	4.93	4.79	240.1	270.1	10.61	10.51	11.18	240.1	270.1	1.08	0.83	0.65
151.6	181.6	5.19	4.95	4.78	257.8	287.8	9.99	9.60	10.16	257.8	287.8	1.25	0.93	0.73
169.3	199.3	5.29	5.04	4.87	275.5	305.5	9.05	9.09	9.47	275.5	305.5	1.43	1.04	0.81
187.0	217.0	5.31	5.04	4.87	293.2	323.2	8.02	8.83	10.18	293.2	323.2	1.63	1.19	0.91
222.4	252.4	5.44	5.16	4.96	310.9	340.9	8.21	9.85	12.08	310.9	340.9	1.78	1.25	0.94
240.1	270.1	5.45	5.22	5.05	328.6	358.6	6.41	10.59	13.64	328.6	358.6	2.01	1.50	1.10
257.8	287.8	5.43	5.24	5.10	346.3	376.3	4.33	8.82	15.99	346.3	376.3	2.00	1.67	1.31
275.5	305.5	5.41	5.21	5.09	363.9	393.9	2.25	5.33	11.08	363.9	393.9	1.99	1.76	1.49
293.2	323.2	5.46	5.19	5.08	381.6	411.6	1.43	3.34	7.25	381.6	411.6	1.90	1.69	1.53
310.9	340.9	5.59	5.31	5.15	399.3	429.3	2.08	3.41	5.95	399.3	429.3	1.68	1.55	1.49
346.3	376.3	6.23	5.62	5.19	417.0	447.0	2.94	3.92	5.87	417.0	447.0	1.40	1.32	1.27
363.9	393.9	6.64	5.98	5.36	434.7	464.7	3.70	4.97	6.58	434.7	464.7	1.17	1.12	1.07
381.6	411.6	6.92	6.28	5.55	452.4	482.4	4.07	5.57	7.07	452.4	482.4	1.10	1.04	1.01
399.3	429.3	7.15	6.50	5.79	470.1	500.1	6.38	8.50	10.40	470.1	500.1	1.07	0.99	0.97
417.0	447.0	7.57	6.99	6.25	487.8	517.8	10.01	12.67	16.66	487.8	517.8	1.14	1.02	0.90
452.4	482.4	8.14	7.44	6.86	505.5	535.5	13.53	16.04	15.00	505.5	535.5	1.20	1.10	0.94
470.1	500.1	8.03	7.40	6.92	523.2	553.2	14.72	13.43	13.07	523.2	553.2	1.34	1.18	0.97
487.8	517.8	7.98	7.42	7.06	540.9	570.9	10.55	13.42	12.55	540.9	570.9	1.49	1.23	1.01
505.5	535.5	8.12	7.55	7.22	558.6	588.6	8.68	12.20	13.85	558.6	588.6	1.51	1.07	0.83
540.9	570.9	7.97	7.45	7.21	576.3	606.3	8.28	11.47	13.65	576.3	606.3	1.39	0.93	0.71
558.6	588.6	7.95	7.52	7.44	593.9	623.9	8.60	10.97	12.11	593.9	623.9	1.38	0.88	0.66
576.3	606.3	8.19	7.87	7.79	611.6	641.6	8.94	11.82	12.88	611.6	641.6	1.33	0.83	0.65
593.9	623.9	8.53	8.17	8.11	629.3	659.3	10.22	12.68	12.12	629.3	659.3	1.30	0.75	0.65
611.6	641.6	8.76	8.45	8.41	647.0	677.0	10.42	10.90	11.99	647.0	677.0	1.13	0.66	0.62
647.0	677.0	9.48	9.19	9.21	664.7	694.7	11.02	10.57	9.90	664.7	694.7	1.05	0.64	0.63
682.4	712.4	10.44	10.16	10.11	682.4	712.4	10.02	9.84	9.42	682.4	712.4	1.19	0.76	0.80
700.1	730.1	10.89	10.62	10.53	700.1	730.1	10.10	11.11	9.05	700.1	730.1	1.32	0.82	0.80

# Frequency Mixer

# TUF-3SM+

## Typical Performance Data

IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=200.1MHz (dB)	IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=10.1MHz (dB)	IF (OUT) (MHz)	LO (MHz)	CONVERSION LOSS VS. IF FREQUENCY @RF(IN)=400.1MHz (dB)
		@LO (dBm)			@LO (dBm)			@LO (dBm)
		+7			+7			+7
190.0	10.1	5.14	10.0	20.1	4.69	390.0	10.1	6.14
185.4	14.7	5.14	19.7	29.8	4.68	380.3	19.8	6.10
180.8	19.3	5.10	29.5	39.6	4.64	370.5	29.6	6.04
176.2	23.9	5.04	39.2	49.3	4.68	360.8	39.3	6.01
171.5	28.6	5.03	49.0	59.1	4.75	351.0	49.1	6.00
166.9	33.2	4.98	58.7	68.8	4.70	341.3	58.8	5.96
162.3	37.8	4.97	68.5	78.6	4.77	331.5	68.6	5.95
157.7	42.4	4.97	78.2	88.3	4.79	321.8	78.3	6.01
153.1	47.0	4.98	87.9	98.0	4.77	312.1	88.0	6.01
148.5	51.6	4.96	97.7	107.8	4.79	302.3	97.8	5.95
143.8	56.3	4.95	107.4	117.5	4.78	292.6	107.5	5.95
139.2	60.9	4.95	117.2	127.3	4.80	282.8	117.3	5.94
134.6	65.5	4.93	126.9	137.0	4.80	273.1	127.0	5.94
130.0	70.1	4.94	136.7	146.8	4.85	263.3	136.8	5.97
125.4	74.7	4.95	146.4	156.5	4.90	253.6	146.5	6.05
120.8	79.3	4.96	156.2	166.3	4.90	243.8	156.3	6.05
116.2	83.9	4.96	165.9	176.0	4.90	234.1	166.0	6.02
111.5	88.6	4.96	175.6	185.7	4.91	224.4	175.7	6.02
106.9	93.2	4.95	185.4	195.5	4.94	214.6	185.5	6.02
102.3	97.8	4.91	195.1	205.2	4.88	204.9	195.2	6.01
97.7	102.4	4.91	204.9	215.0	4.87	195.1	205.0	6.02
93.1	107.0	4.94	214.6	224.7	4.93	185.4	214.7	6.01
88.5	111.6	4.95	224.4	234.5	4.93	175.6	224.5	5.97
83.8	116.3	4.96	234.1	244.2	5.01	165.9	234.2	5.92
79.2	120.9	4.95	243.8	253.9	5.19	156.2	243.9	5.96
74.6	125.5	4.95	253.6	263.7	5.27	146.4	253.7	5.96
70.0	130.1	4.95	263.3	273.4	5.23	136.7	263.4	5.92
65.4	134.7	4.94	273.1	283.2	5.26	126.9	273.2	5.97
60.8	139.3	4.93	282.8	292.9	5.21	117.2	282.9	5.98
56.2	143.9	4.95	292.6	302.7	5.08	107.4	292.7	5.88
51.5	148.6	4.95	302.3	312.4	5.11	97.7	302.4	5.90
46.9	153.2	4.93	312.1	322.2	5.07	87.9	312.2	5.92
42.3	157.8	4.95	321.8	331.9	4.97	78.2	321.9	5.85
37.7	162.4	4.96	331.5	341.6	4.99	68.5	331.6	5.75
33.1	167.0	4.96	341.3	351.4	4.97	58.7	341.4	5.65
28.5	171.6	4.99	351.0	361.1	4.97	49.0	351.1	5.65
23.8	176.3	5.01	360.8	370.9	5.11	39.2	360.9	5.70
19.2	180.9	4.98	370.5	380.6	5.18	29.5	370.6	5.77
14.6	185.5	5.05	380.3	390.4	5.14	19.7	380.4	5.95
10.0	190.1	5.04	390.0	400.1	5.19	10.0	390.1	6.03

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## Typical Performance Data

LO (MHz)	LO-RF ISOLATION (dB)			LO-IF ISOLATION (dB)		
	@LO (dBm)			@LO (dBm)		
	+4	+7	+10	+4	+7	+10
0.15	82.59	77.37	74.58	60.69	63.67	66.98
0.2	83.04	77.64	74.35	60.44	63.64	66.75
0.3	82.49	77.00	74.12	60.19	63.40	66.52
0.5	81.86	76.78	74.01	60.36	63.48	66.51
1.0	80.26	76.45	73.66	60.46	63.55	66.86
1.5	80.37	75.88	73.40	60.37	63.58	66.40
2.0	79.14	75.76	73.07	60.34	63.46	66.57
5.0	77.84	74.18	72.40	60.54	63.18	65.20
10.0	74.42	72.35	70.36	59.32	61.65	63.66
27.8	63.36	64.37	64.63	65.82	64.86	63.03
45.5	59.13	60.10	60.69	61.27	59.10	58.04
98.6	52.71	53.38	53.86	52.07	52.15	51.66
116.3	50.71	51.70	52.21	51.00	51.11	50.48
133.9	49.83	50.33	50.90	48.95	49.53	48.82
151.6	49.09	50.12	50.47	48.78	49.06	47.96
169.3	46.78	47.47	48.21	48.66	48.85	47.25
187.0	45.40	45.85	46.04	49.47	48.40	47.07
222.4	45.59	45.68	45.92	47.27	45.31	43.31
240.1	46.94	46.37	46.00	44.01	42.26	40.97
257.8	49.47	48.54	47.19	42.36	40.12	38.69
275.5	53.60	51.81	49.42	44.13	39.87	37.68
293.2	49.36	48.94	47.44	46.76	40.23	37.20
310.9	46.45	48.13	48.53	50.46	40.02	36.05
346.3	43.55	46.50	48.48	43.66	36.70	32.41
363.9	43.37	46.26	49.20	38.59	35.36	31.91
381.6	43.61	46.24	49.52	35.50	33.67	31.30
399.3	46.01	50.53	59.92	32.90	31.38	29.23
417.0	45.82	49.32	53.26	30.76	29.64	27.85
452.4	43.93	45.55	47.26	27.62	26.66	25.59
470.1	42.42	43.87	45.53	26.75	25.85	24.76
487.8	39.39	39.99	40.47	25.79	25.09	23.81
505.5	37.41	38.12	37.97	24.69	24.25	22.78
540.9	33.55	34.16	33.19	22.22	22.21	20.41
558.6	32.20	33.05	31.90	21.18	21.39	19.33
576.3	30.41	31.10	29.80	20.16	20.30	18.32
593.9	28.62	29.15	27.73	18.89	19.10	17.27
611.6	26.80	27.33	26.40	17.39	17.51	16.24
647.0	23.27	23.69	23.30	14.91	15.10	14.35
682.4	20.87	21.10	20.88	13.92	13.89	13.07
700.1	20.19	20.35	20.16	13.64	13.45	12.65

RF (IN) (MHz)	LO (MHz)	RF-IF ISOLATION (dB)		
		@LO (dBm)		
		+4	+7	+10
10.1	40.1	41.02	36.72	39.99
27.8	57.8	31.44	32.31	32.00
45.5	75.5	28.16	28.67	28.44
63.2	93.2	26.34	26.37	26.37
80.9	110.9	24.81	25.10	25.16
98.6	128.6	23.64	23.75	24.00
116.3	146.3	23.28	23.47	23.65
133.9	163.9	22.66	23.09	23.33
151.6	181.6	22.34	22.83	23.38
169.3	199.3	22.24	22.56	22.94
187.0	217.0	22.96	23.18	23.38
204.7	234.7	24.00	24.27	24.42
222.4	252.4	25.41	26.21	26.83
240.1	270.1	25.85	27.03	28.34
257.8	287.8	24.66	25.82	26.80
275.5	305.5	22.30	22.91	23.41
293.2	323.2	20.22	20.34	20.39
310.9	340.9	18.84	18.70	18.56
328.6	358.6	17.74	17.42	17.23
346.3	376.3	16.94	16.73	16.59
363.9	393.9	16.36	16.21	16.15
381.6	411.6	16.28	16.17	16.10
399.3	429.3	16.54	16.31	16.22
417.0	447.0	17.05	16.85	16.72
434.7	464.7	17.22	17.06	16.93
452.4	482.4	17.00	16.93	16.97
470.1	500.1	16.33	16.36	16.44
487.8	517.8	15.44	15.47	15.58
505.5	535.5	14.77	14.88	14.83
523.2	553.2	13.94	13.88	13.69
540.9	570.9	13.20	13.04	12.70
558.6	588.6	12.41	12.06	11.56
576.3	606.3	11.44	11.02	10.43
593.9	623.9	10.63	10.17	9.67
611.6	641.6	9.69	9.25	8.81
629.3	659.3	8.83	8.41	8.00
647.0	677.0	8.05	7.67	7.34
664.7	694.7	7.36	7.02	6.68
682.4	712.4	6.95	6.61	6.36
700.1	730.1	6.62	6.30	6.07

# Frequency Mixer

# TUF-3SM+

## Typical Performance Data

RF (IN) (MHz)	LO (MHz)	RF VSWR (:1)		
		@LO (dBm)		
		+4	+7	+10
5.0	35.0	1.27	1.21	1.22
10.0	40.0	1.19	1.09	1.07
27.8	57.8	1.33	1.22	1.15
45.5	75.5	1.37	1.25	1.16
63.2	93.2	1.30	1.23	1.15
80.9	110.9	1.30	1.20	1.14
98.6	128.6	1.28	1.19	1.13
116.3	146.3	1.29	1.18	1.12
133.9	163.9	1.27	1.18	1.12
151.6	181.6	1.27	1.17	1.10
169.3	199.3	1.25	1.16	1.11
187.0	217.0	1.24	1.16	1.11
204.7	234.7	1.20	1.11	1.08
222.4	252.4	1.21	1.12	1.09
240.1	270.1	1.18	1.12	1.10
257.8	287.8	1.15	1.09	1.09
275.5	305.5	1.11	1.05	1.07
293.2	323.2	1.07	1.02	1.07
310.9	340.9	1.11	1.02	1.03
328.6	358.6	1.22	1.12	1.07
346.3	376.3	1.37	1.25	1.19
363.9	393.9	1.54	1.43	1.33
381.6	411.6	1.70	1.58	1.47
399.3	429.3	1.85	1.73	1.60
417.0	447.0	2.14	2.01	1.85
434.7	464.7	2.34	2.19	2.03
452.4	482.4	2.42	2.26	2.10
470.1	500.1	2.40	2.26	2.12
487.8	517.8	2.40	2.27	2.17
505.5	535.5	2.55	2.42	2.34
523.2	553.2	2.58	2.45	2.38
540.9	570.9	2.52	2.41	2.34
558.6	588.6	2.48	2.40	2.34
576.3	606.3	2.52	2.45	2.39
593.9	623.9	2.57	2.52	2.45
611.6	641.6	2.58	2.51	2.45
629.3	659.3	2.51	2.45	2.41
647.0	677.0	2.51	2.45	2.42
664.7	694.7	2.49	2.44	2.41
682.4	712.4	2.47	2.41	2.37
700.1	730.1	2.43	2.35	2.32

LO (MHz)	LO VSWR (:1)		
	@LO (dBm)		
	+4	+7	+10
5.0	1.81	2.60	3.64
10.0	1.71	2.50	3.52
27.8	1.58	2.44	3.49
45.5	1.58	2.37	3.40
63.2	1.51	2.21	3.12
80.9	1.49	2.14	2.98
98.6	1.50	2.19	3.06
116.3	1.57	2.30	3.22
133.9	1.62	2.36	3.29
151.6	1.61	2.30	3.18
169.3	1.60	2.26	3.10
187.0	1.62	2.29	3.13
204.7	1.70	2.39	3.26
222.4	1.77	2.47	3.36
240.1	1.82	2.50	3.35
257.8	1.82	2.49	3.34
275.5	1.84	2.50	3.35
293.2	1.90	2.57	3.44
310.9	1.98	2.66	3.54
328.6	2.06	2.70	3.55
346.3	2.12	2.73	3.54
363.9	2.19	2.81	3.60
381.6	2.27	2.94	3.76
399.3	2.35	3.08	3.94
417.0	2.43	3.17	4.07
434.7	2.46	3.18	4.07
452.4	2.48	3.17	4.05
470.1	2.53	3.22	4.09
487.8	2.60	3.30	4.19
505.5	2.68	3.37	4.25
523.2	2.72	3.38	4.23
540.9	2.75	3.36	4.16
558.6	2.78	3.37	4.14
576.3	2.85	3.40	4.15
593.9	2.93	3.45	4.18
611.6	3.03	3.51	4.21
629.3	3.18	3.59	4.25
647.0	3.36	3.73	4.32
664.7	3.54	3.88	4.43
682.4	3.67	4.03	4.55
700.1	3.73	4.11	4.61

IF (OUT) (MHz)	IF VSWR @LO=400.1MHz (:1)		
	@LO (dBm)		
	+4	+7	+10
5.0	1.67	1.41	1.23
10.0	1.68	1.41	1.23
20.0	2.01	1.61	1.31
30.0	2.16	1.75	1.44
40.0	2.23	1.84	1.50
50.0	2.28	1.86	1.53
60.0	2.24	1.85	1.52
70.0	2.25	1.84	1.52
80.0	2.20	1.81	1.52
90.0	2.28	1.88	1.54
100.0	2.31	1.89	1.57
110.0	2.28	1.90	1.58
120.0	2.27	1.89	1.58
130.0	2.28	1.89	1.59
140.0	2.31	1.92	1.61
150.0	2.37	1.99	1.66
160.0	2.44	2.04	1.71
170.0	2.42	2.04	1.72
180.0	2.38	2.01	1.70
190.0	2.32	1.96	1.66
200.0	2.29	1.94	1.65
210.0	2.26	1.94	1.67
220.0	2.29	1.96	1.70
230.0	2.36	2.03	1.75
240.0	2.40	2.08	1.81
250.0	2.39	2.08	1.83
260.0	2.34	2.05	1.81
270.0	2.30	2.00	1.77
280.0	2.32	2.00	1.76
290.0	2.30	2.01	1.79
300.0	2.30	2.04	1.83
310.0	2.33	2.04	1.85
320.0	2.33	2.05	1.85
330.0	2.31	2.05	1.86
340.0	2.28	2.02	1.85
350.0	2.30	2.02	1.83
360.0	2.33	2.03	1.83
370.0	2.36	2.07	1.85
380.0	2.35	2.05	1.86
390.0	2.28	2.01	1.84
400.0	2.28	2.02	1.87

## Harmonics Tables

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	16	31	11	52	19	43	24	39	37	47
1	-	19	+0	24	11	35	30	42	38	43	39	48
2	>100	57	56	55	57	56	51	72	59	67	59	>81
3	>100	76	71	74	65	72	65	77	73	72	66	75
4	>100	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81
5	>100	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81
6	>100	>81	>81	>81	>81	>81	78	>81	>81	>81	>81	>81
7	>100	>81	>81	>81	>81	>81	>81	72	>81	>81	>81	>81
8	>100	>81	>81	>81	>81	>81	>81	>81	62	>81	>81	>81
9	>100	>81	>81	>81	>81	>81	>81	>81	>81	75	>81	>81
10	>100	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81	>81
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

### LO HARMONICS ORDER

Test conditions: RF IN: 200.1 MHz; -14.00 dBm.  
 LO IN: 230.01 MHz; +7.00 dBm  
 IF OUT: 29.91 MHz; -19.24 dBm

RF HARMONICS ORDER

	(-dBm)	(-dBc)										
0	-	-	26	39	21	55	30	61	39	50	50	60
1	-	19	+0	25	11	34	32	48	38	48	45	57
2	>100	54	50	52	52	50	46	64	53	58	52	66
3	>100	51	41	49	45	53	39	65	55	55	53	56
4	>100	68	68	66	64	64	64	66	62	83	67	76
5	>100	70	60	56	51	62	51	63	53	65	68	68
6	>100	89	86	84	79	81	78	84	>91	79	87	90
7	>100	89	90	83	75	69	71	72	67	75	67	82
8	>100	>91	>91	>91	>91	>91	86	87	70	89	81	86
9	>100	>91	88	>91	90	>91	76	78	76	79	79	90
10	>100	>91	>91	>91	>91	>91	>91	>91	>91	>91	89	>91
	RF CAL	0	1	2	3	4	5	6	7	8	9	10

### LO HARMONICS ORDER

Test conditions: RF IN: 200.1 MHz; -4.00 dBm.  
 LO IN: 230.01 MHz; +7.00 dBm  
 IF OUT: 29.91 MHz; -9.22 dBm

- Notes: 1. All Harmonics are in (dBc) relative to IF OUTPUT.  
 2. + entry denotes harmonics are in (dBc) above IF OUTPUT.  
 3. RF Cal represent the Harmonics level of the RF input signal to the mixer.

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